

-EG & G

R.A/E

B-2063



EDGERTON, GERMESHAUSEN & GRIER, INC.

FIREBALL CALCULATIONS
SHOT HUMBOLDT
OPERATION HARDTACK PHASE II
PROJECT 15.1

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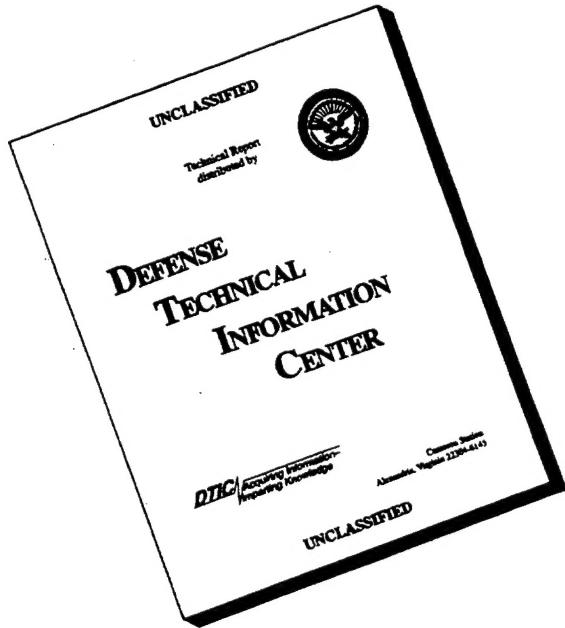
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PER NTPR REVIEW.

Robert L. Grier DATE 4/25/92

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REPORT NO. B-2063
4 MARCH 1960

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ISST

29 May 1996

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ATTENTION: OCD/MR. BILL BUSH

SUBJECT: Documents for DTIC System

There is no record of your office receiving the following reports:

EGG-B-2064 (4 March 1960)
Fireball Calculations Shot
Wrangell Operation Hardtack
Phase II, Project 15.1

EGG-B-2063 (4 March 1960)
Fireball Calculations Shot Humboldt
Operation Hardtack Phase II
Project 15.1

Both documents are now approved for public release.

Therefore, we are transmitting copies for inclusion into the DTIC system, if not found there.

Enclosure:
A/S

Ardith Jarrett
ARDITH JARRETT
Chief, Technical Support

DTIC QUALITY INSPECTED 4)

FIREBALL CALCULATIONS
SHOT HUMBOLDT
OPERATION HARDTACK, PHASE II
PROJECT 15.1

Report No. B-2063
4 March 1960

Prepared by J. E. Campbell
J. E. Campbell

Approved by D. F. Seacord, Jr.
D. F. Seacord, Jr.

EDGERTON, GERMESHAUSEN & GRIER, INC.
Boston, Mass. Santa Barbara, Calif. Las Vegas, Nev.

FIREBALL CALCULATIONS - SHOT HUMBOLDT

1.0 INTRODUCTION

Shot Humboldt was a thirty-foot tower shot sponsored by LRL and detonated on 29 October 1958 in Area T-3V of the Nevada Test Site at 0645 FST.

The fireball yield was 3.3 tons \pm 0.3 ton.

2.0 CAMERA INSTRUMENTATION AND OPERATION

Photographic coverage of fireball growth was provided by four high-speed Eastman cameras, two each at Station 3-357 (Transporter No. 3) and Station 3-358 (White Truck No. 2). Two Rapatronic cameras were located at each of these stations to record early fireball growth. In addition, a 15,000 frame-per-second EG&G Framing camera was used, located at Station 3-358 (6 x 6 No. 1). All cameras produced good records of this low-yield tower shot.

Station locations together with burst location are shown in Figure 1. Figure 2 is a summary of the survey data.

3.0 RESULTS

Application of phi-comparison (EG&G Report No. B-1869) indicates a yield of 3.3 tons \pm 0.3 ton for Shot Humboldt.

An air density of 1.097 grams per liter was used in the yield calculations, based on a pressure of 885 millibars, a temperature of 7.4°C, and a relative humidity of 46% at the height of the device at shot time.

The following table shows the comparison shots and the Humboldt yield obtained by the phi-comparison.

Comparison Shot	Humboldt Yield (Tons)
<u>Air Drop</u>	
Osage	3.35
Ranger A	3.17
Buster B	3.20
Wasp	3.41
Wasp'	3.41
Ranger E	3.25
<u>Balloon</u>	
Rushmore	3.51
Hidalgo	3.36
Lea	3.46
<u>Tower</u>	
Post	3.26
UK-3	3.25
Chaves	3.53
Hornet	3.33
Moth	3.19
Quay	3.24
$\bar{W} = 3.3$ tons	

Diameter vs time and phi vs time plots are shown in Figs. 3 and 4.

The following data sheets are included for each film:

- a) Photo Plan and Photo Loading Chart
- b) Camera Data and Calculation Sheet
- c) Diameter Measurement Sheet
- d) E-102 Print-Out Sheet of D, t, and ϕ

The zero-frame times of the Eastman and Framing camera records were determined by comparison with the Rapatronic diameter-time data.

Appendix A contains photographic examples of the Humboldt fireball.

840

(TRANSPORTAINER NO. 3)

3-357

BURST

3-358
(6X6*) → 3-358
WHITE TRUCK NO. 2

330

-4-

920

FIG. 1

NEVADA TEST SITE
AREA T3 V
SHOT HUMBOLDT

310

E670 E680 E690

E700

FIG. 2

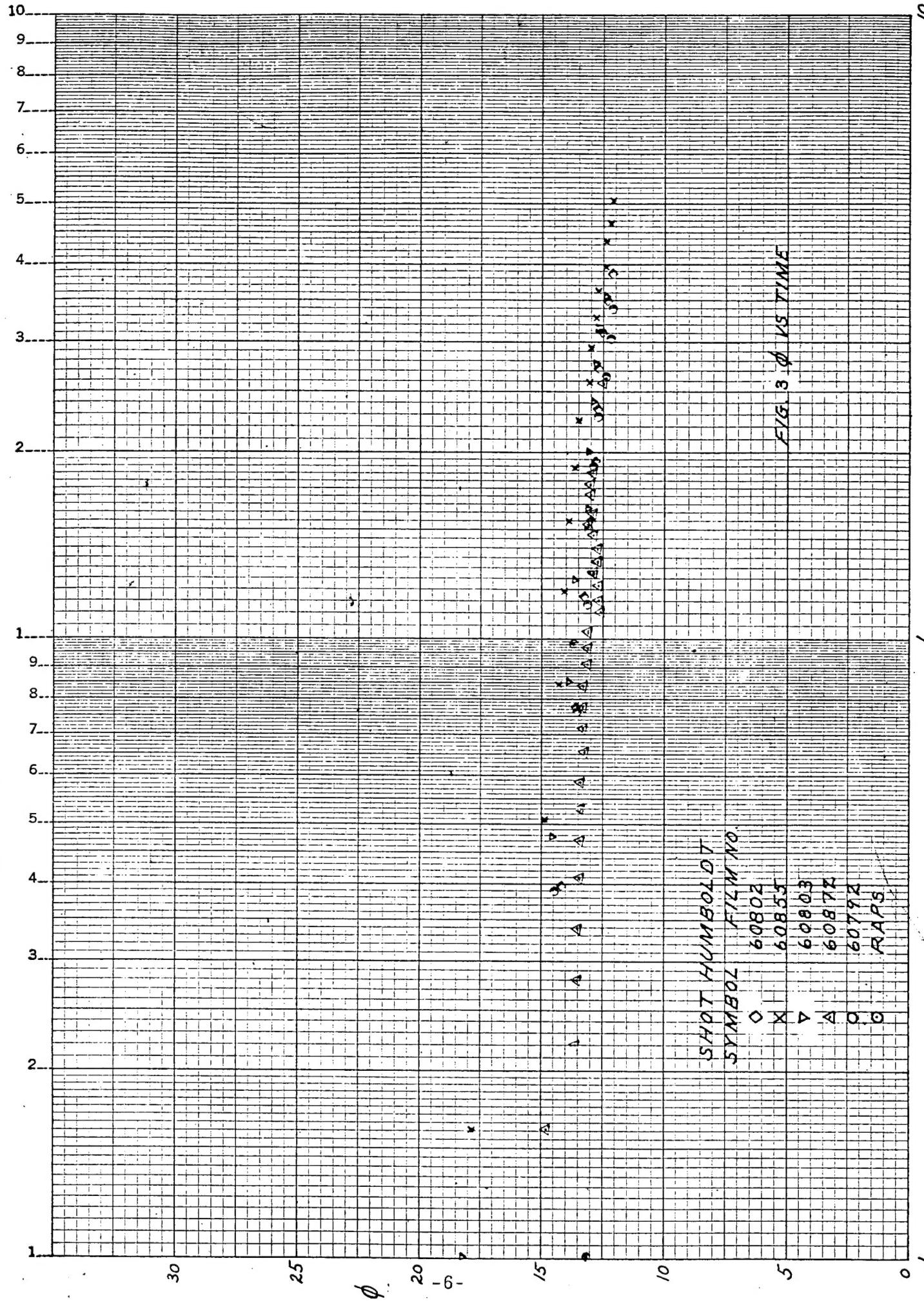
SURVEY

DATA STA. T3V

DATE 10/29/58

HUMBOLDT

HUMB
GZ STA. T³V
DATA



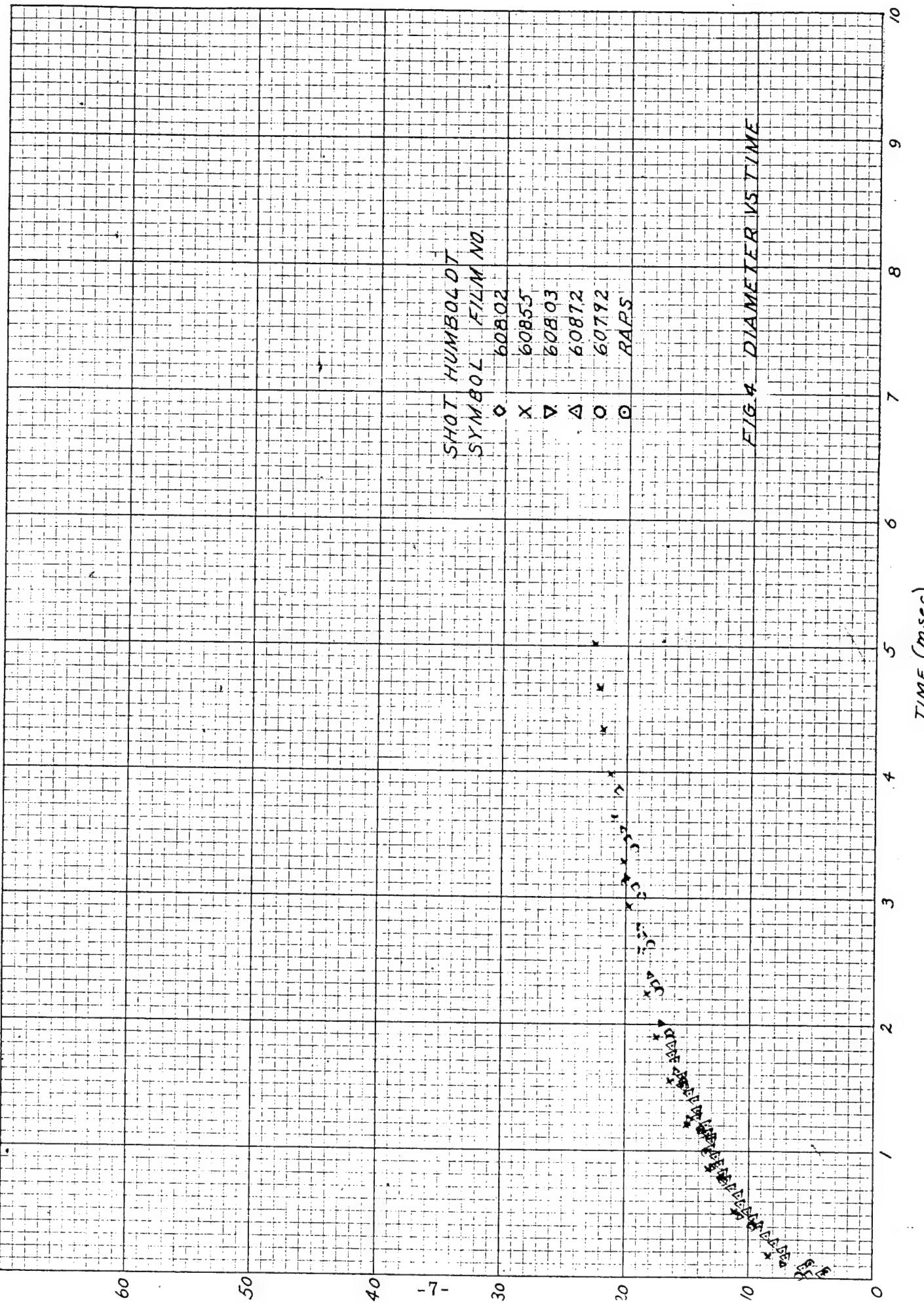


Table I

Hardtack Phase II, Humboldt
Fireball Camera Distribution

Station	Camera	Qualitative Functioning
3-357 Transportainer No. 3	E-33	Record
	E-1	Record
	R-34	Record
	R-30	Record
3-358 White Truck No. 2	E-11	Record
	E-5	Record
	XR-3	Record
	R-4	Record
3-358 6 x 6 No. 1	Framing	Record

Table II

Hardtack Phase II, Humboldt
Average Diameter vs Time

Time (m sec)	Diameter (meters)
0.5	10.5
1.0	13.5
1.5	15.5
2.0	17.0
2.5	18.5
3.0	19.5
3.5	20.0
4.0	21.0

Table III

Hardtack Phase II, Humboldt

Rapatronic Summary

Station	Film No.	Camera No.	Horizontal Range (m)	F. L. (mm)	Diameter (m)	Time (ms)
3-357	60851	R-34	2339.3	479.03	13.67	0.99
	60852	R-30	2339.3	479.30	3.75	0.05
3-358	60794	XR-3	2163.9	476.76	5.21	0.10
	60795	R-4	2163.9	477.82	20.17	3.15

PHOTO LOADING CHART

STATION 3-358 6x6 #1

DATE 10/29/58

EVENT

三

ECON E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

TATION NO. 3-358TATION TYPE WHITE TRUCK No. 2INSTANCE GZ 7099.4 ftINSTANCE OBJECT 700.0 ft**PHOTO PLAN**EVENT HUMBOLDTGZ STA. T 3 VBRG 21° 03'TILT 0° / 3'DIFF. 6626GZ 0° / 3'OBJ 0° 28'POSTED 10/31/58DATE 10/29/58POSTED 10/31/58

GZ

N 830 358E 684 829Z 3 997

Aiming

Object

H

V

Shut.

Rheo.

On/Off

Type

S/N

Delay

Film

Purpose

CAMERA	LENS	FIELD TARGET	AIMING	POWER	MARKER	REMARKS
NO.	RACK POS.	FOC. MM	S/N	FILTER	OBJECT	
E-11	2500	C-1	305	784691	ND-1	F. B.
E-5	2500	C-2	254	876312	W-12	F. B.
X-3	400	A-1	480	774695	ND-1	F. B.
X-4	400	A-2	480	773952	-	F. B.
Z-3	64	C-3	18.5	11026	=	DOC.
Z-10	64	C-3	18.5	12297	=	DOC.
Z-10	64	C-3	18.5	2.590	2.590	
						ACTUAL RAP DELAYS
						X R-3
						R-4

* INCLUDES 30 ft, HEIGHT OF TOWER

SEA 100 A

FINAL

PHOTO LOADING CHART

STATION 3-357 TRANSPORTAINER NO. 3

VENT HUMBOLDT

DATE 10/29/58

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DSO 50

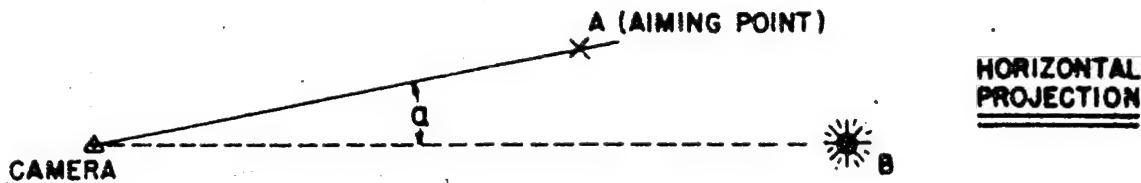
CAMERA

卷五

FINAL
EDGERTON GERMESHAUSEN B. GRIER INC.

CAMERA DATA & CALCULATIONS

FILM NO. 60794	STATION NO. ^{WHITE TRUCK NO. 2} 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. XR-3	EQ. AP.		DATE: 12/1/58



A. $R/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
------------------------	-----------------------	-------------------------

$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
-------------------------	-------------------------	-------------------------

$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
---------------------------	-------------------------	---

$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R/A = 2163.93 \text{ m}$
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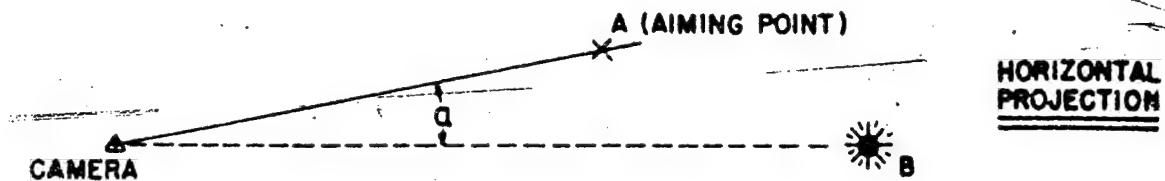
B. FOCAL LENGTH 476.76 mm (774695)

C. MAGNIFICATION FACTOR (meters/in.) 115.29

D. ZERO TIME CORRECTION 0.10 msec delay

CAMERA DATA & CALCULATIONS

FILM NO. 60795	STATION NO. ^{WHITE TRUCK NO. 2} 3-358	TEST HUMBOLDT	CALCULATED BY: JE.
CAMERA NO. R-4	EQ. AP.		DATE: 12/1/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
------------------------	-----------------------	-------------------------

$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
-------------------------	-------------------------	-------------------------

$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
---------------------------	-------------------------	---

$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^0/A = 2163.93 \text{ m}$
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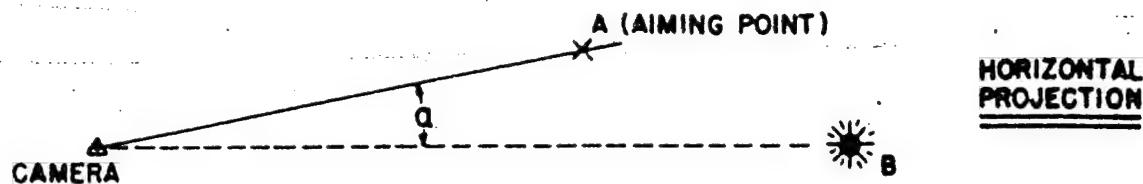
B. FOCAL LENGTH $477.82 \text{ mm (773952)}$

C. MAGNIFICATION FACTOR (meters/in.) 115.03

D. ZERO TIME CORRECTION 3.15 msec delay

CAMERA DATA & CALCULATIONS

FILM NO. 60851	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. R-34	EQ. AP.		DATE: 12/14/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 27'$	$H_B = 4054 \text{ ft}$
------------------------	-----------------------	-------------------------

$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
-------------------------	------------------------	-------------------------

$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
---------------------------	------------------------	--

$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0/A = 2339.3 \text{ m}$
--	--	----------------------------

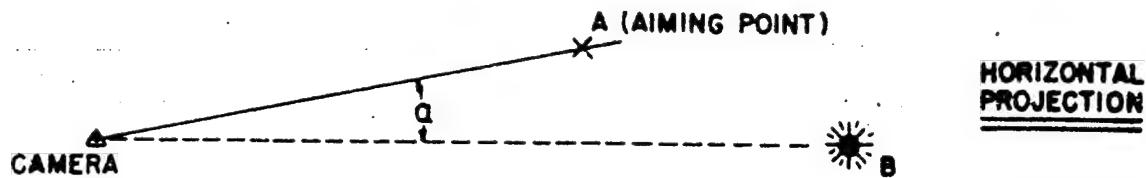
B. FOCAL LENGTH 479.03 mm (773948)

C. MAGNIFICATION FACTOR (meters/in.) 124.04

D. ZERO TIME CORRECTION 0.99 msec delay

CAMERA DATA & CALCULATIONS

FILM NO. 60852	STATION NO. 3357 <small>TRANSFIRER No. 3</small>	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. R-30	EQ. AP.		DATE: 12/1/58



A. $R^{\circ}A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 27'$	$H_B = 4054 \text{ ft}$
------------------------	-----------------------	-------------------------

$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
-------------------------	------------------------	-------------------------

$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
---------------------------	------------------------	--

$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^{\circ}A = 2339.3 \text{ m}$
--	--	---------------------------------

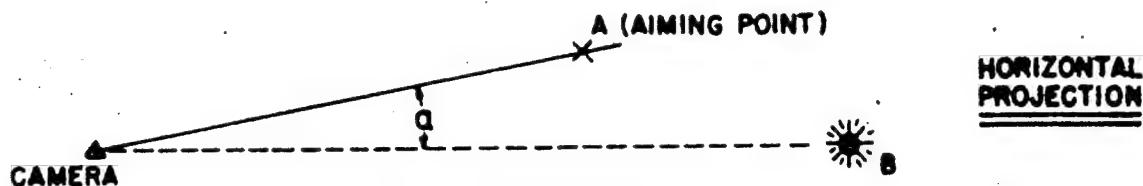
B. FOCAL LENGTH 479.30 mm (773953)

C. MAGNIFICATION FACTOR (meters/in.) 123.97

D. ZERO TIME CORRECTION 0.05 msec delay

CAMERA DATA & CALCULATIONS

FILM NO. 60855	STATION NO. <small>WHITE TRUCK NO. 2</small> 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-5	EQ. AP.		DATE: 10/29/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
------------------------	-----------------------	-------------------------

$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
-------------------------	-------------------------	-------------------------

$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
---------------------------	-------------------------	---

$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^0/A = 2163.93 \text{ m}$
--	--	-----------------------------

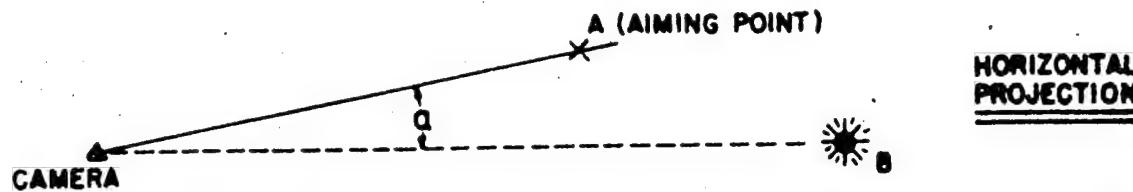
B. FOCAL LENGTH 250.2 mm (876312)

C. MAGNIFICATION FACTOR (meters/in.) 219.68

D. ZERO TIME CORRECTION 0.16 msec

CAMERA DATA & CALCULATIONS

FILM NO. 60855	STATION NO. ^{WHITE TRUCK NO. 2} 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-5	EQ. AP.		DATE: 10/29/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^0/A = 2163.93 \text{ m}$

B. FOCAL LENGTH 250.2 mm (8763/12)

C. MAGNIFICATION FACTOR (meters/in.) 219.68

D. ZERO TIME CORRECTION 0.16 msec

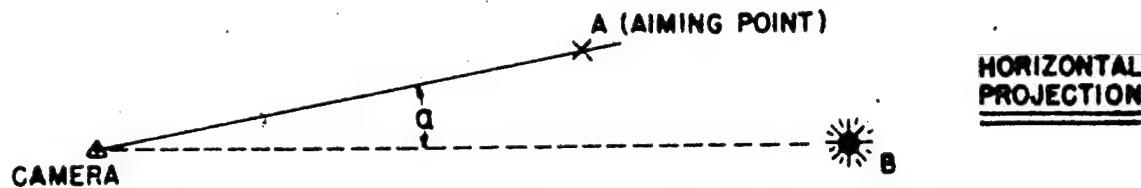
FIREBALL CALCULATIONS

SHOT HUMBOLDT FILM NO. 60855DATE

D	t	In D	Int	$t^{2/5}$	ϕ
8.53	.16	2.14766	1.83250 -	.480463	177.53
11.99	.34	2.42384	.67335 -	.763882	147.79
17.38	.65	2.59377	1.6245 -	.937085	142.78
15.05	1.20	2.71145	1.8225	10.75626	139.91
15.49	1.55	2.80283	43833	11.91642	138.38
17.55	1.90	2.86511	54187	12.92721	135.76
18.50	2.25	2.91780	.81086	13.83128	133.75
19.03	2.59	2.94604	.95158	14.63210	130.05
19.96	2.94	2.99870	1.07837	15.59373	129.01
20.43	3.29	3.01699	1.19090	16.10207	126.87
21.27	3.64	3.04782	1.29204	16.76684	125.66
21.45	3.99	3.05568	1.33386	17.39412	123.31
22.06	4.35	3.09371	1.47024	18.00558	122.51
22.51	4.68	3.11320	1.54733	18.53981	121.41
22.75	5.03	3.12629	1.61542	19.08217	119.74

CAMERA DATA & CALCULATIONS

FILM NO. 60802	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-33	EQ. AP.		DATE: 12/1/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 27'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0/A = 2339.3 \text{ m}$

B. FOCAL LENGTH 306.9 mm (784702)

C. MAGNIFICATION FACTOR (meters/in.) 193.6

D. ZERO TIME CORRECTION 0.01 msec

DIAMETER MEASUREMENTS

SHOT HUMBOLDT

FILM NO. 60802

READ BY LW **JEC** **TYPED BY**

DATE 10/29/58 **DATE**

REMARKS:

FIREBALL CALCULATIONS

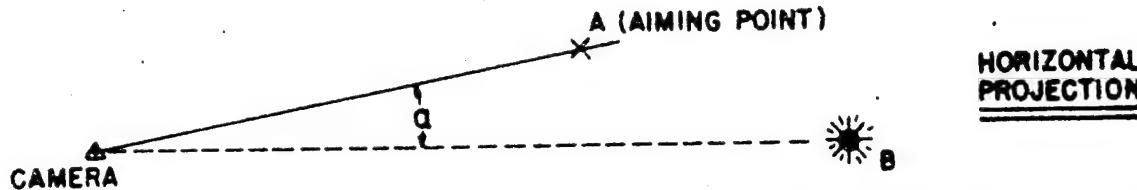
SHOT HUMBOLDT FILM NO. 60802

DATE _____

D	t	In D	Int	$t^{2/5}$	ϕ
5.23	.01	1.65439	4.60509 -	.159054	328.79
9.79	.40	2.28133	916.21 -	6.93164	141.23
12.30	.78	2.50955	248.44 -	9.05399	135.85
14.04	1.17	2.64195	156.93	10.64784	131.85
15.38	1.55	2.73314	438.33	11.91642	129.06
16.55	1.94	2.80646	662.69	13.03533	126.96
17.69	2.33	2.87305	845.79	14.02588	126.12
18.75	2.71	2.93175	996.88	14.89965	125.90
19.50	3.10	2.97042	1131.39	15.72327	124.01
20.13	3.48	3.00220	1247.07	16.46795	122.23
20.60	3.87	3.02527	1353.32	17.18293	119.88

CAMERA DATA & CALCULATIONS

FILM NO. 60803	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-1	EQ. AP.		DATE: 12/1/58



A. $R^0/A = CB_h \cos a \cos \beta + (H_B - H_c) \sin \beta$

$a = 0^\circ 00'$	$\beta = -0^\circ 4'$	$H_B = 4054 \text{ ft}$
$\cos a = 1.00000$	$\cos \beta = 1.00000$	$H_c = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00116$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos a \cos \beta = 2339.4 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0/A = 2339.4 \text{ m}$

B. FOCAL LENGTH 541.6 mm (C73377)

C. MAGNIFICATION FACTOR (meters/in.) 109.7

D. ZERO TIME CORRECTION 0.10 msec

DIAMETER MEASUREMENTS

SHOT HUMBOLDT

FILM NO. 60803

READ BY plw rh **TYPED BY** _____

DATE 10/29/58 DATE

REMARKS:

FIREBALL CALCULATIONS

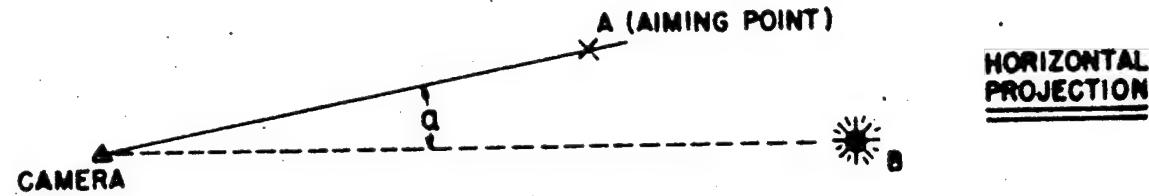
SHOT HUMBOLDT FILM NO. 60803

DATE _____

D	t	In D	Int	$t^{2/5}$	ϕ
7.26	.10	1.98234	2.30251 -	3.98119	18235
10.79	.48	2.37856	733.94 -	7455.90	14471
13.05	.96	2.56878	150.75 -	9414.80	13861
14.85	1.25	2.69307	223.10	10933.45	13582
15.96	1.63	2.77015	438.65	12158.73	13126
17.16	2.01	2.84265	699.12	13221.37	12978
18.23	2.40	2.90311	875.39	14192.90	12844
19.08	2.78	2.94866	1022.39	15052.47	12675
20.05	3.17	2.99822	1153.73	15864.40	12638
20.50	3.55	3.02040	1267.00	16599.71	12349

CAMERA DATA & CALCULATIONS

50792	STATION NO. ^{WHITE TRUCK NO. 2} 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
2 E-11	EQ. AP.		DATE: 12/1/58



$$= C B_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$$

	$\beta = 0^\circ 29'$	$H_B = 4054 \text{ ft}$
00000	$\cos \beta = 0.99996$	$H_C = 3997 \text{ ft}$
53.9 m	$\sin \beta = 0.00844$	$\Delta H = 57 \text{ ft} = 17.37 \text{ m}$
$\cos \beta = 2163.8 \text{ m}$	$\Delta H \sin \beta = 0.1 \text{ m}$	$R^0/A = 2163.9 \text{ m}$
AL LENGTH 305.9 mm (784691)		

MAGNIFICATION FACTOR (meters/in.) 179.68

NO TIME CORRECTION 0.01 msec

DIAMETER MEASUREMENTS

SPOT HUMBOLDT

FILM NO. 60792

READ BY plw jc rm

DATE 10/29/58 **DATE** _____

REMARKS:

-30-

**EDGERTON, GERMESHAUSEN
& GRIER, INC.**

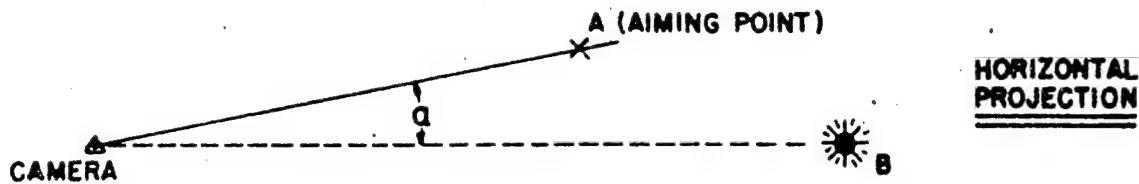
FIREBALL CALCULATIONS

SHOT HUMBOLDTFILM NO. 60792DATE

b	t	In D	Int	$t^{2/5}$	ϕ
6.00	.01	1.79168	4.60509 -	.1 59064	377 20
9.86	.39	2.28844	94153 -	6 86180	143 69
12.23	.76	2.50384	27444 -	8 96034	136 49
13.85	1.14	2.62832	13095	10 53776	131 43
15.32	1.51	2.72923	41218	11 79242	129 91
16.50	1.89	2.80343	63659	12 89997	127 90
17.42	2.27	2.85768	81971	13 88031	125 50
18.16	2.64	2.89926	97070	14 74446	123 16
18.90	3.02	2.93918	110523	15 55961	121 46
19.57	3.40	2.97400	122381	16 31539	119 94

CAMERA DATA & CALCULATIONS

0872	STATION NO. ³⁻³⁵⁸ _(6x6#)	TEST HUMBOLDT	CALCULATED BY: JEC
FRAMING	EQ. AP.		DATE: 1/29/60



$$CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$$

0'	$\beta = 0^\circ 29'$	$H_B = 4054 \text{ ft}$
10000	$\cos \beta = 0.99996$	$H_C = 3997 \text{ ft}$
4.7m	$\sin \beta = 0.00844$	$\Delta H = 57 \text{ ft} = 17.37 \text{ m}$
$\cos \beta = 2164.6 \text{ m}$	$\Delta H \sin \beta = 0.1 \text{ m}$	$R^0/A = 2164.7 \text{ m}$

L LENGTH

IFICATION FACTOR (meters/in.)

TIME CORRECTION 0.03 msec $\frac{1}{2}$ fr

DIAMETER MEASUREMENTS

HUMBOLDT

FILM NO. 60872

READ BY

JEC RCS

TYPED BY

DATTE

1 / 29 / 60

DATE

REMARKS:

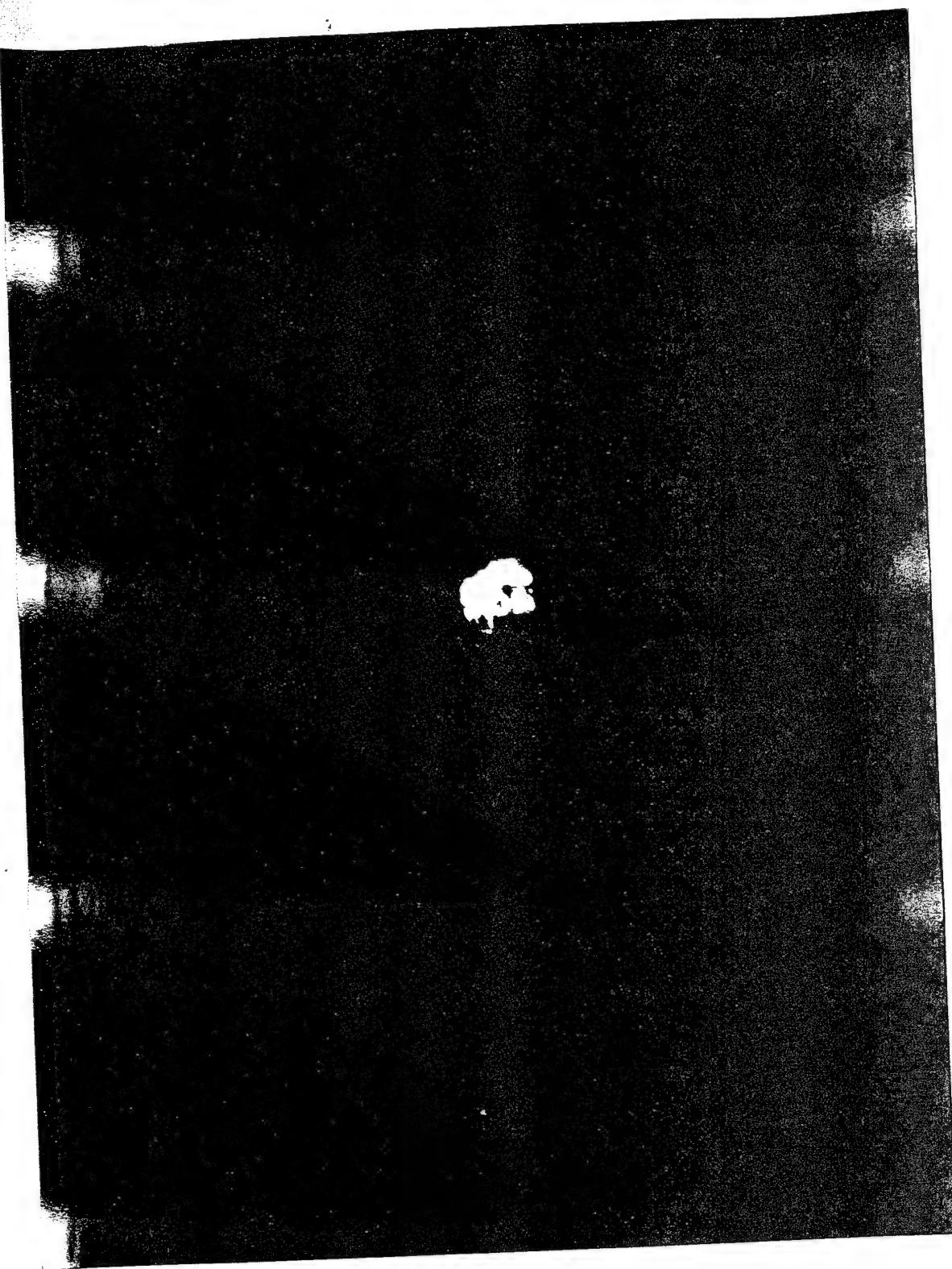
FIREBALL CALCULATIONS

SHOT HUMBOLDTFILM NO. 60872

DATE _____

D	t	In D	Int	$t^2/5$	ϕ
4.16	.03	1.42559	3.50658 -	2.45999	16910
5.72	.09	1.74390	2.40787 -	3.81691	14985
7.13	.16	1.06427	1.83250 -	4.80463	14839
7.46	.22	2.00954	1.51418 -	5.45706	13670
8.14	.28	2.09683	1.27302 -	6.00969	13544
8.80	.34	2.17482	1.07977 -	6.49526	13548
9.41	.41	2.24181	89152 -	7.00045	13441
9.91	.47	2.29349	75498 -	7.39341	13403
10.39	.53	2.34083	63490 -	7.75720	13393
10.85	.59	2.38410	52770 -	8.09707	13399
11.19	.66	2.41404	41559 -	9.46845	13213
11.73	.72	2.46208	32854 -	8.76851	13377
12.14	.78	2.49645	24844 -	9.05399	13408
12.37	.84	2.51523	17429 -	9.32657	13263
12.66	.91	2.53842	9424 -	9.63003	13146
12.98	.97	2.56340	3046 -	9.87886	13139
13.35	1.03	2.59153	2956	10.11896	13193
13.10	1.10	2.57261	9524	10.38831	12610
13.55	1.16	2.60641	14834	10.61133	12769
13.77	1.22	2.62252	19879	10.82766	12717
14.38	1.28	2.66589	24683	11.03774	13028
14.33	1.34	2.66241	29268	11.24200	12746
14.74	1.41	2.69063	34363	11.47343	12847
15.11	1.47	2.71543	38532	11.66642	12951
15.60	1.53	2.74735	42534	11.85466	13159
15.55	1.60	2.74414	47008	12.06872	12884
16.24	1.72	2.78755	54238	12.42288	13072
16.48	1.78	2.80222	57666	12.59438	13085
16.53	1.85	2.80525	61521	12.79011	12924

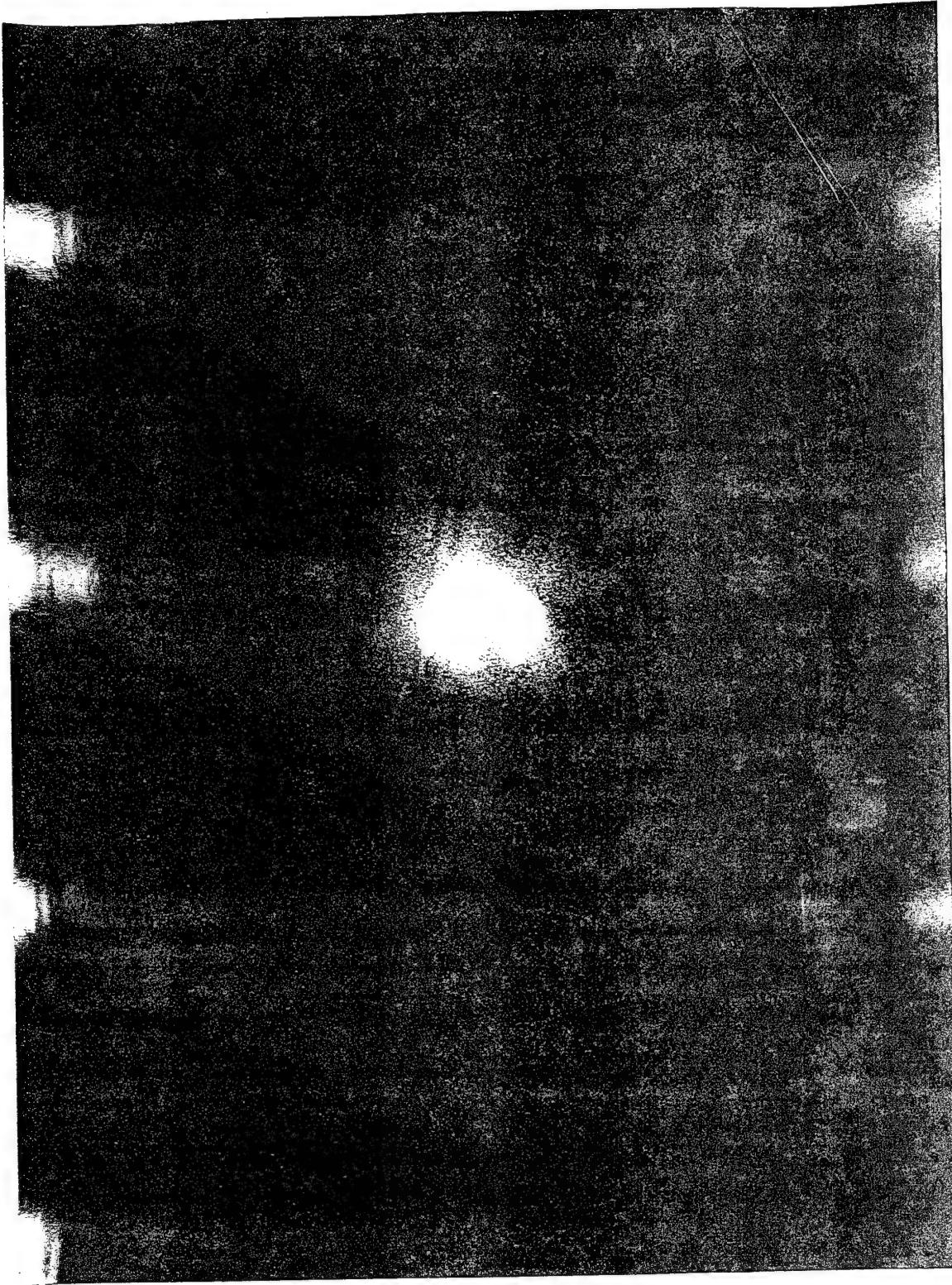
APPENDIX A
HARDTACK PHASE II, HUMBOLDT
PHOTOGRAPHIC EXAMPLES



Camera: Rapatronic-30

Station: 3-357

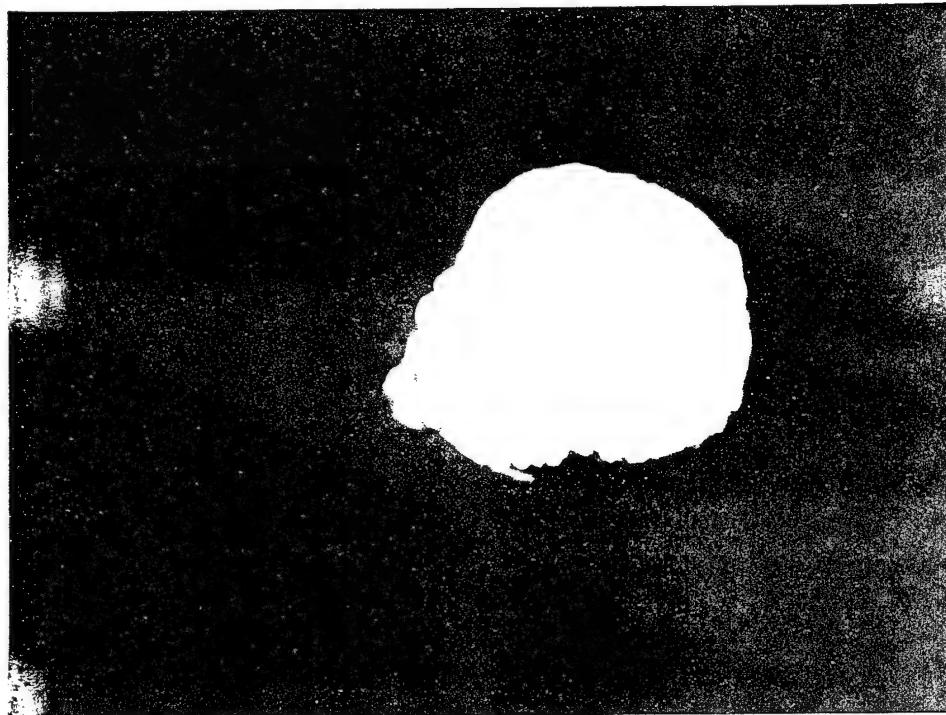
Time: 0.05 msec



Camera: XR-3

Station: 3-358

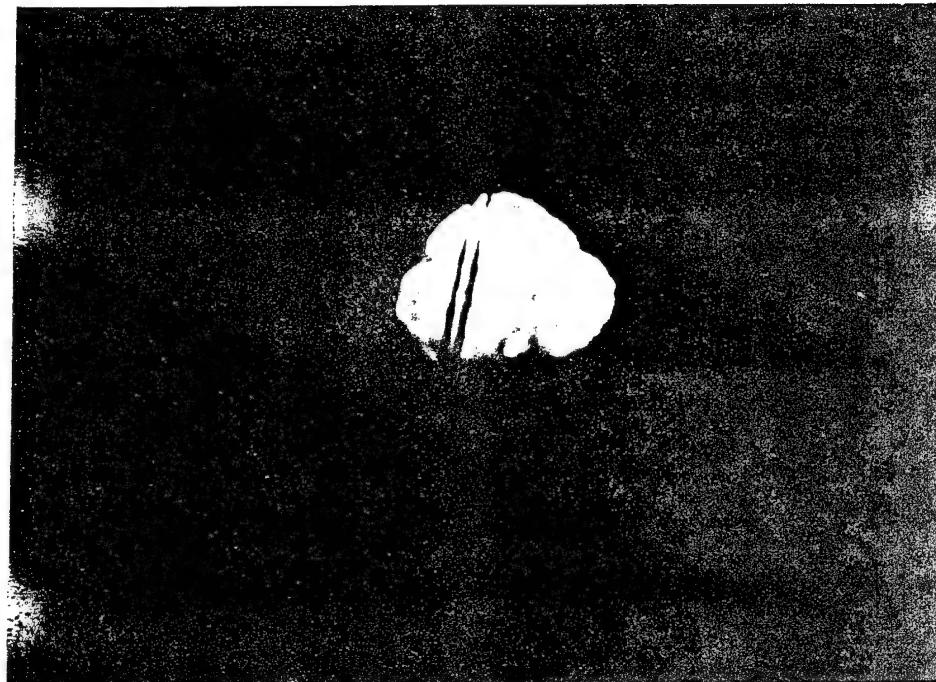
Time: 0.10 msec



Camera: E-1

Station: 3-357

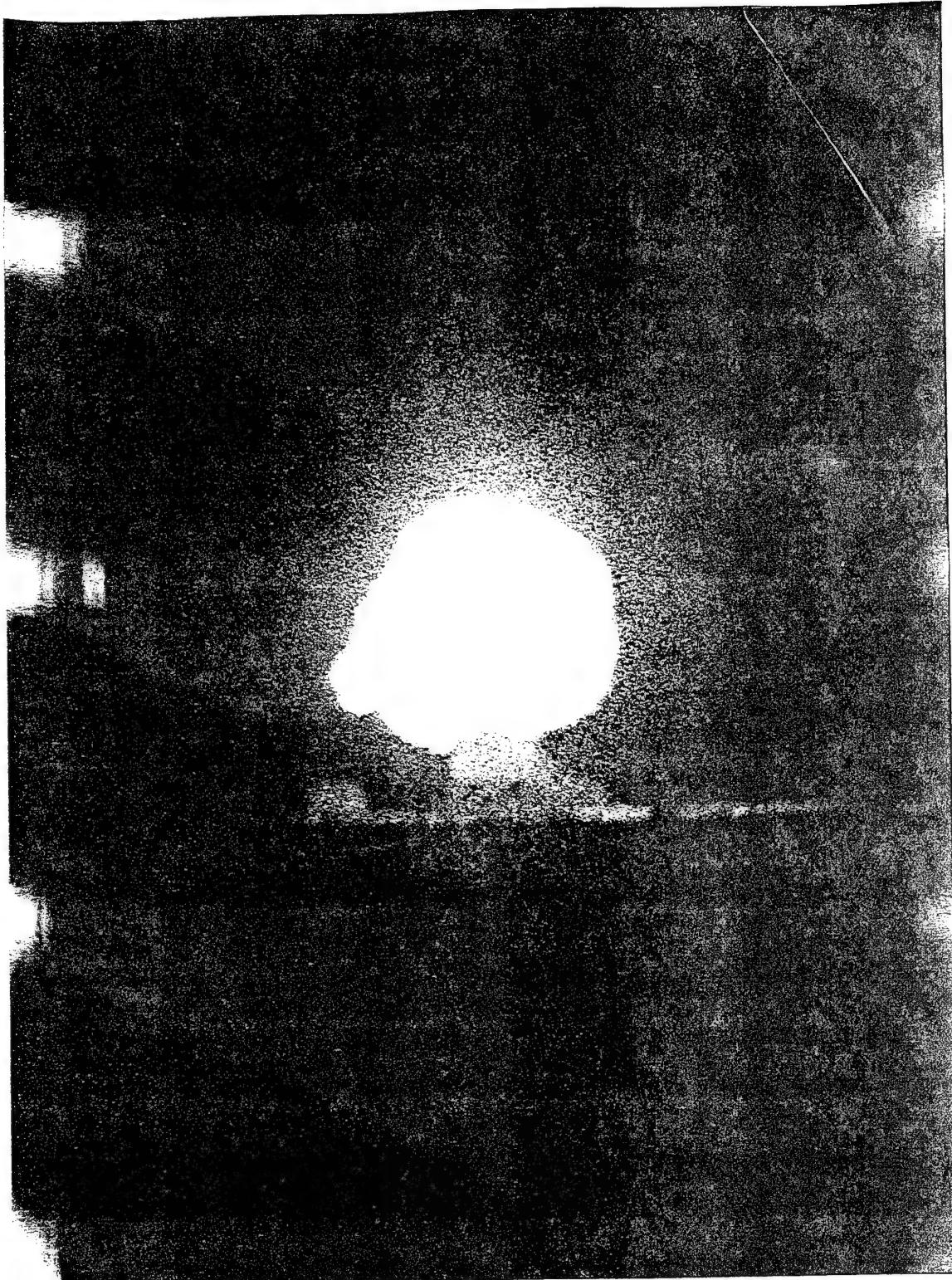
Time: 0.48



Camera: E-11

Station: 3-358 (White Truck No. 2)

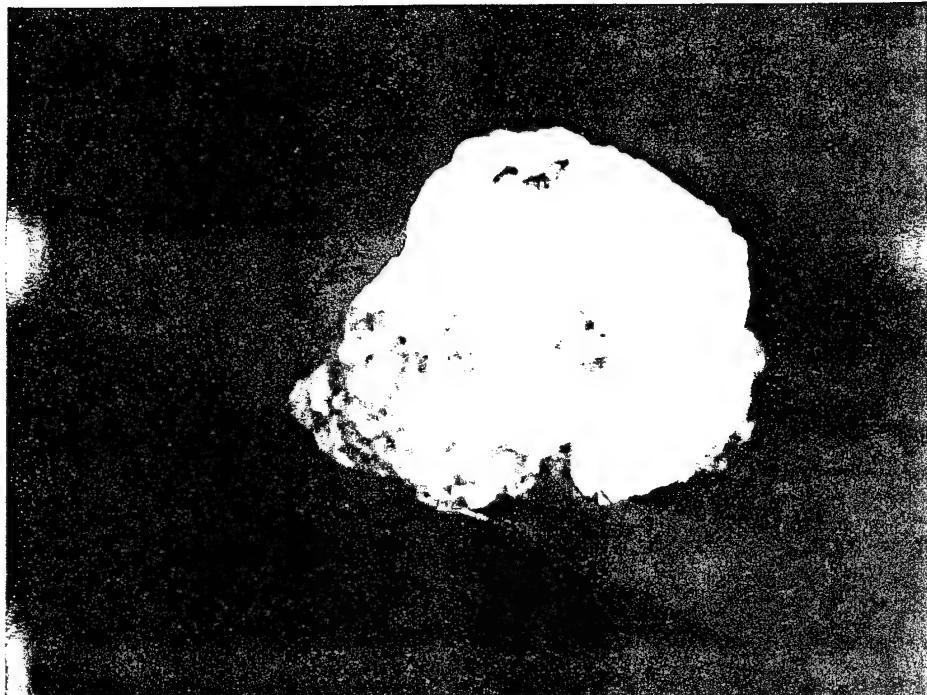
Time: 0.76 msec



Camera: Rapatronic R-34

Station: 3-357

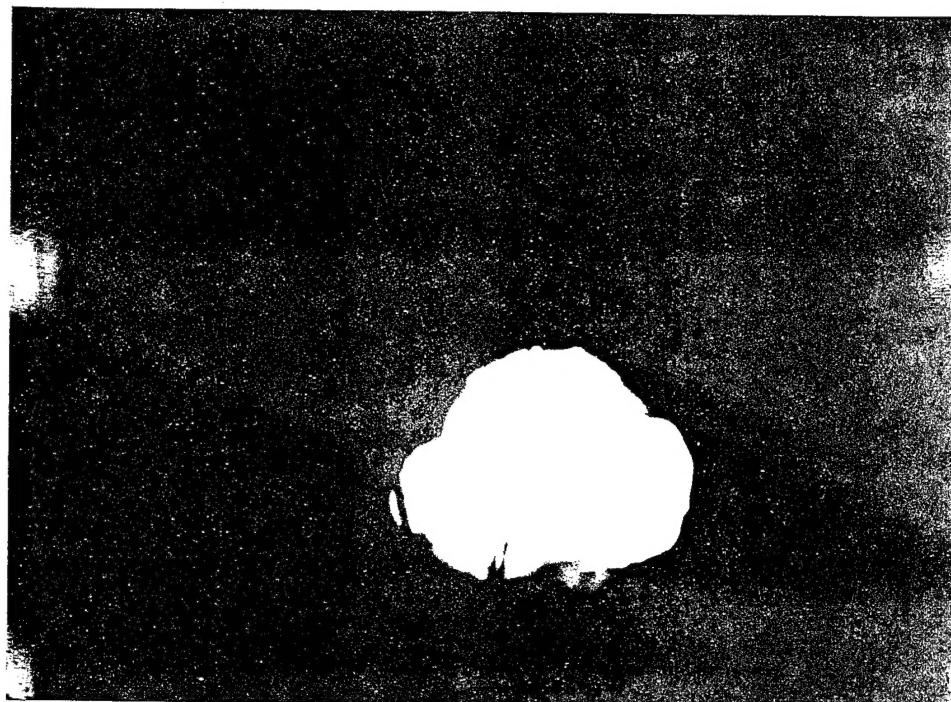
Time: 0.99 msec



Camera: E-1

Station: 3-357

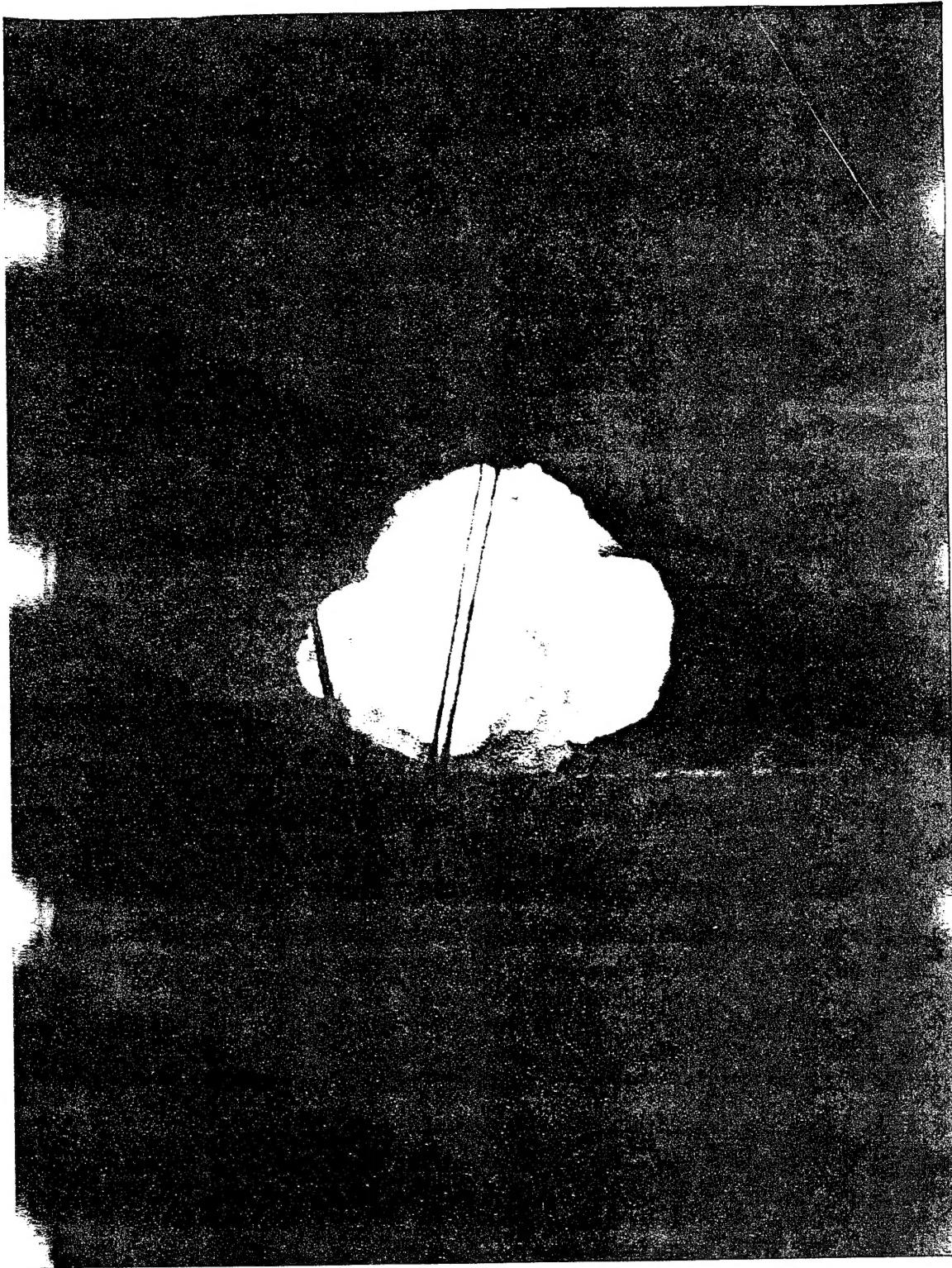
Time: 1.63 msec



Camera: E-5

Station: 3-358

Time: 2.94 msec



Camera: R-4

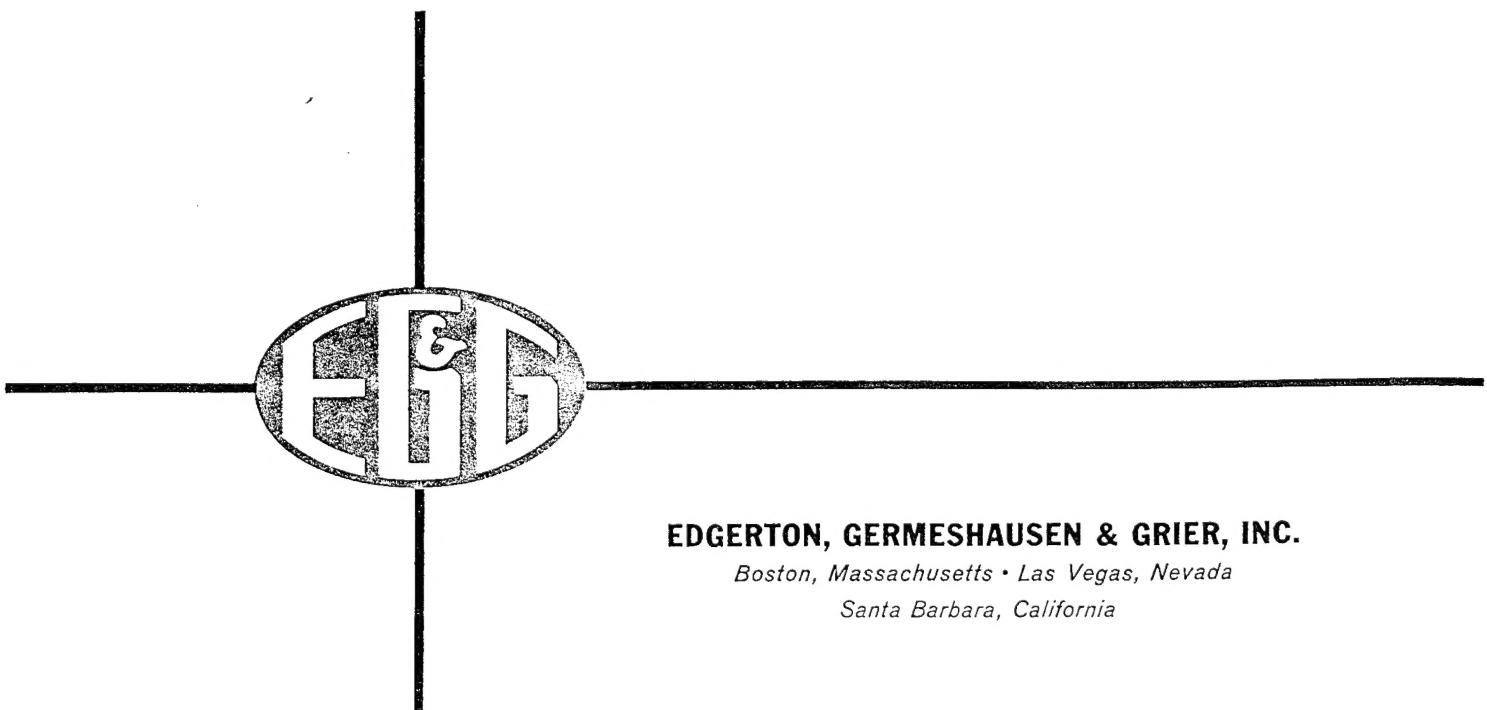
Station: 3-358

Time: 3.15 msec

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